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AERONAUTICAL DECISION MAKING FOR AIR AMBULANCE HELICOPTER PILOTS: LEARNING FROM PAST MISTAKES

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Final Report

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16. Abstract

The following materials are based upon actual helicopter air ambulance accidents. They focus on the importance of decision making and judgement during all phases of flight. Improving safety is a shared responsibility between hospital administrators, vendors, chief pilots, head nurses, pilots, air medics, dispatchers and physicians. It is to everyones advantage to establish and support an operational frame [illegible] that will ensure safety.

These accident synopses are the first element of a multi-volume set of training materials designed to significantly reduce the helicopter air ambulance accident rate and to keep it under control thereafter. The other volumes include:

Aeronautical Decision Making for Helicopter Pilots
Aeronautical Decision Making for Air Ambulance Helicopter Pilots: Situational Awareness Exercises
Risk Management for Air Ambulance Helicopter Operators
Aeronautical Decision Making for Air Ambulance Helicopter Program Administrators

The accident summaries, risk anayses and lessons learned are taken directly from helicopter air ambulance history. They enhance the basic manual: "Aeronautical Decision Making for Helicopter Pilots" by providing an insight to the types of decision errors which contributed to accidents in the past. This manual contains introductory and tutorial material necessary for improving basic decision making skills. Some material contained in that manual and not included in this one are: rotorcraft risk assessment; the self-awareness inventory; identifying and reducing stress; and headwork. Reading and understanding the concepts of decision making will improve the pilot's ability to analyze the accident scenarios contained herein.

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1.0 INTRODUCTION

Learning from past mistakes is one-half of a two part addendum to the basic "Aeronautical Decision Making for Helicopter Pilots" manual. It is provided as a bridge between the decision making concepts and techniques of the manual. The primary purpose of this material is to give you an insight on the past mistakes of helicopter air ambulance pilots that have caused accidents. A secondary purpose is to combat the hazardous attitude that "It won't happen to me."

The case file summaries, risk analysis, hypotheses (assumptions), lessons learned and recommended preventative actions provide you with a thorough knowledge base. Hopefully, you will apply this knowledge during all of your flying activities. In order to reinforce this knowledge to the point of automatic recall, it is necessary for you to practice the exercises in the second part of this addendum: "Situational Awareness Exercises". Understanding the problem is critical as the first step.

The accident summaries presented in this document provide a source from which helicopter air ambulance pilots can learn lessons from history. The material presented is based on a review of NTSB helicopter accident case files for a two year period. The relevant accident scenarios selected were based upon the statistical accident profile which showed that:

- 86% of the accidents occurred en route
- 67% were weather related
- 48% occurred at night in marginal weather
- 19% occurred during daytime marginal weather
- 19% occurred during night VMC
- 14% occurred during day VMC
- 14% occurred during takeoff/departure

Clearly, the majority of these accidents involved flight with reference to instruments to some degree. Yet, day-to-day helicopter flying is predominantly VMC regardless of pilot experience, qualifications or mission. It is for this reason that diligent effort must be made to understand the demands of both the flying skills and decision making required to insure safety during flight at night or in marginal weather.

It has been estimated that air ambulance helicopters have saved approximately one million lives over the last 40 years -- when flown safely. However, the cost of recent (1985-86) accidents both in human life and in material resources has been escalating to unacceptable proportions. The tragedy of these losses would be compounded if we fail to learn from them. By using the knowledge so dearly gained from these accidents, it is hoped that we can reduce or prevent their reoccurrence.

2.0 LOSS OF CONTROL ACCIDENTS

2.1 Loss of Control -- Night -- En route -- Fog Bank

SUMMARY: The single engine, turbine helicopter was on a return leg of a heart patient transfer. The aircraft had been dispatched that morning with the transponder removed and a leaky pitot static system. The return to the base hospital was launched at 3:00 p.m. local time after refueling and receiving reported weather at destination as 700 feet and 3 miles.

Within eight miles of his destination the pilot encountered deteriorating weather and requested a special VFR clearance to enter the Control Zone. Center advised the pilot to "hang around for a bit" until inbound IFR traffic had landed. Witnesses saw the pilot doing 180's up and down a local freeway at about 300 - 400 feet.

The SVFR clearance was received 28 minutes after it was requested with an estimated maximum of 20 minutes of fuel remaining. Five minutes later the pilot declared "I have a Mayday, I'm inadvertent IFR and things look pretty bad." The helicopter impacted the ground in a 15 degree nose down and 15 degree roll right attitude with the engine and transmission both indicating greater that 100% rated power. There were 3 fatalities.

RISK ANALYSIS

Pilot Factors:

1. The pilot failed to assess the risk factors and took no action to change the situation. First, he did not properly assess the deteriorating weather upon initially encountering marginal VMC conditions. Second, he did not request weather conditions at any alternates or make any attempt to exit the deteriorating conditions.

2. The added stress of low fuel quantity, coupled with the progressively lower ceiling and visibility, decreased the pilot's ability to handle the inadvertent IMC workload.

Aircraft Factors:

The bad weather flying capability of the aircraft was questionable with two necessary items inoperative. A safer policy would have been to ground the aircraft for no transponder and the leaky pitot static system.

Environmental Factors:

The 28 minute hold within 8 miles of his destination was an added, unexpected change which added to the stress on the pilot and increased the time of exposure to risk.

Operational Factors:

1. Keeping the helicopter in service with 2 items broken provided a negative reinforcement for pushing the limits and encountering IMC.

2. The operating philosophy should have addressed routine vs. emergency ATC procedures. A stated policy of requesting priority due to low fuel and IMC would have taken that decision away from the pilot during a high workload, high stress situation.

HYPOTHESES:

1. The familiarity with the local area and the fact that he was instrument qualified in fixed wing aircraft probably lead to overconfidence and a mind set of invulnerability.

2. The effect of questionable airspeed, altitude, and vertical speed instruments on the pilot's decision making may have provided a disincentive for going IMC.

3. The exact reasons for the pilot's inability to assess the risk factors are not known, however, fear, indecision, and inadequate response to the changes that occurred may all have played a role.

LESSONS LEARNED:

Spatial disorientation was the ultimate cause of this accident. The result was loss of attitudinal control and impact with the ground at cruise airspeed or greater. The final destruction of the aircraft and three deaths took only 23 seconds after the initial encounter with IMC.

Disorientation does not have to result in flying an aircraft into an unrecoverable position. If the pilot had been instrument trained, current and proficient in helicopter instrument flight the accident may not have happened. If he had admitted the seriousness of the situation first to himself and then made it known to ATC in a timely fashion the accident might not have happened. Finally, if the pilot and the vendor had a clearly stated and agreed upon plan for inadvertant IMC, the accident may have been prevented.

PREVENTATIVE ACTIONS:

1. Always maintain an acute awareness of your current flight situation vs. planned progress and alternative actions.

2. Whenever anything deviates from your expectations question the validity of continuing the flight as planned vs. the possible reduction in safety.

3. Do not underestimate the seriousness of inadvertant IMC and the difficulty of flying a helicopter on instruments.

4. When you do encounter IMC, don't let the situation progress to the "Mayday" stage. Admit your problem and ask for help.

5. Do not fall in the "It won't happen to me!" (Invulnerability) trap.

6. Develop and live by a minimum equipment list for your operation e.g. VOR, ILS, Transponder, etc.

7. Develop a coordinated procedure for inadvertent IMC with your local Flight Standards district office and local air traffic control facility.

2.2 Loss of Control -- Predawn -- En route -- Freezing Rain & Wet Snow

SUMMARY: In the predawn darkness with local ceilings reported less than 1000 feet, and visibility less than 3 miles an air ambulance helicopter was dispatched for an inter-hospital patient transfer. The sky was overcast and light snow and fog conditions existed. The pickup was about 140nm from the departure hospital. The patient non-critical. Witnesses near the crash site reported seeing the helicopter transition the area at about 300 feet and 80 knots in "textbook" icing conditions. The visibility near the crash was 1/4 mi. The helicopter impacted the ground in a near vertical, nose low attitude. No pre-impact failures or deficiencies were found.

The pilot of the single engine, turbine helicopter held a commercial certificate with an instrument rating. He had nearly 2300 total hours, 271 hours in make & model and 54 hours in the last 90 days. He had obtained a weather briefing from the nearest flight service station at 5:52 a.m. which included a "chance of IFR conditions" and a flight precaution for light to occasionally moderate rime icing in clouds and in precipitation. Weather was forecast to be 1200' broken with a chance of three miles in light snow and fog. Outlook was marginal VFR due to ceilings. The aircraft lifted off at 6:05 a.m. Inflight weather service was available but not used.

The last radio communication was received at 6:25 a.m. The crash occurred in a sparsely populated hilly area at 6:55 a.m. There were 3 fatalities.

RISK ANALYSIS

Pilot Factors:

1. The pilot did not properly assess the risk of flying in the existing and forecast weather vs the urgency of repositioning the aircraft for the patient transport.

2. The pilot did not utilize all available information (i.e. inflight weather service) and showed either lack of knowledge/experience or lack of respect for inadvertant IMC and possible icing.

Aircraft Factor:

Loss of performance due to icing was a distinct possibility based upon the FSS precaution and the local observed conditions.

Environmental Factor:

As predicted, marginal VFR conditions existed. Local ceilings were below 1000 feet (witnesses reported 400 feet & 1/4 mi.).

Operational Factor:

It is difficult to reconstruct the motivation for repositioning an aircraft in the dark with existing weather conditions.

HYPOTHESES:

1. There may have been mission pressures based upon past experience, operator procedures or patient scheduling.

2. The pilot's decision making may have been impaired due to the time of day. He may not have been not thinking clearly as a result of not being fully awake, or been prone to snap judgments.

LESSON LEARNED:

Total loss of control was the ultimate result of the failure to properly assess the risks associated with this flight. The currency of the pilots instrument training is not known, but the results indicate a probable lack of proficiency. However, the primary lesson to be learned is to avoid "scud running" at all times. There is no sense in exposing yourself, the crew and the aircraft to the high risk of an accident in order to complete a mission, satisfy a boss or doctor, or impress your peers.

Since helicopter operations are conducted at low altitudes most of the time, safe frame of reference weather minimums should be established beforehand by the operator with his pilots. Then when the weather comes down and hits that limit, either land immediately or when IMC climb and file IFR.

PREVENTATIVE ACTIONS:

1. Preflight planning and thorough risk assessment while still on the ground is your best deterrent to this type of accident.

2. Remember, if any of the four risk elements: pilot, aircraft, environment or operation are "no-go" you should either cancel the flight or reschedule.

3. Establish minimums for both day and night flying in your operation. Include considerations of local terrain, local weather phenomena and pilot experience level.

4. Eliminate launch pressures from the start by setting and supporting a safe operational frame of reference.

5. Develop risk assessment for your operation based on knowledge of pilots, operations, terrain, etc.

2.3 Loss of Control -- Night -- En route -- Thick Fog

SUMMARY: The request for an automobile accident patient transfer came at 3:34 a.m. The patient needed to be picked up at the attending hospital 50 miles away and transported back to the helicopters base hospital for follow-on care. The dispatch log listed the severity of the diagnosis as "Urgent" vs. "Critical or "Non-Urgent").

The 8500 hour instrument rated helicopter ATP delayed departure about 15 minutes to check weather. Flight service reported that IMC prevailed to the west of a line between departure and destination and VFR was not recommended. Local weather at departure was 800' and 1/3 mi with fog. This weather was well above the takeoff minimums specified by the helicopter operator.

The flight departed VFR at 3:49 a.m. The helicopter was not in contact with any FAA ATC agency during the flight. The helicopter was instrument equipped, but the autopilot was not installed.

The hospital dispatcher received a routine "Five minutes from landing." communication at 4:10 a.m. Shortly after this call, a surviving flight nurse reported that the helicopter suddenly entered thick fog. She next felt a left hand turn. Following the turn "all of a sudden there were trees everywhere".

The helicopter crashed into a wooded area in level attitude after completing about 160 degrees of turn. There were two fatalities. Individuals from the local area stated that lakes within 1 mile of the accident site had a tendency to generate fog frequently at this time of the morning. Heavy ground fog prevented locating the wreckage for 6 hours.

RISK ANALYSIS

Pilot Factors:

1. The pilot did not properly utilize the available meteorological information, the recommendation of the weather briefer or the available en route air traffic control and weather service.

2. The pilot either had insufficient local knowledge or did not rationally consider the possible conditions near the local lakes with a two degree spread between ambient temperature and dew point in December.

Aircraft Factor:

The absence of the autopilot should have been considered in light of the existing and forecast weather.

Environmental Factor:

FSS weather reports are inadequate for remote helicopter operations, so the pilot must be intimately familiar with the weather patterns of his flying area and know what to expect.

Operational Factor:

The "company" minimums of the helicopter operator were unrealistically low for a night cross country flight. They may have lured (or pressured) the pilot into a dangerous situation.

HYPOTHESES

1. The "company" minimums did not provide the support pilots sometimes need to make the correct go/no-go decision when operational pressures are placed on pilots by doctors or administrators.

2. The pilot may have had difficulty making clear decisions due to the time of the mission, his work schedule, the program set-up (i.e. 2, 3 or 4 pilots) or fatigue.

LESSONS LEARNED: Spatial disorientation in IMC and loss of attitude control can happen quickly even to a high time, highly qualified, instrument rated pilot. Without frequent proficiency flights and current instrument skills he is an accident waiting to happen. Administrators and supervisors must provide adequate time and budget for initial training, recurrent training and safety awareness.

A high degree of respect and caution should be signalled whenever minimums are below 1000'/3 mi, especially at night and especially when weather specialists say VFR is not recommended.

Each operation must consider all available information, evaluate the risk elements and make the safest possible decision. Act, don't react - you may not have time.

PREVENTATIVE ACTIONS:

1. Set realistic minimums and evaluate each situation to see if they should be raised. For example, are there are known obstructions or possible local weather phenomena en route? Do not accept unsafe minimums. If you are tired or in any way not up to peak performance, raise your minimums.

2. Make go/no-go decisions consistent with information available regarding the aircraft, the environment, the operation and yourself.

3. Take the time to learn about basic weather phenomena and refresh your knowledge frequently using available FAA publications, AOPA materials, etc.

4. Learn how to draw inferences about expected weather encounters in your operating area by talking to other pilots, flight service personnel and your own analysis of frequently flown routes.

5. Do not accept or comply with unsafe company minimums. Exercise good judgment and make your reasons known. Lives depend on it. Yours and those of your medical flight crew.

2.4 Disorientation -- Night -- En route -- Partial Fog

SUMMARY: The Part 135 helicopter air ambulance was dispatched at 10:19 p.m. The repositioning flight was required to pick up a patient for inter-hospital transfer. Once airborne, the pilot called Flight Service for an en route weather briefing. There was no current weather report available for his destination. However, weather was available from an hourly report at a location 60 miles southwest of his destination. Flight Service reported clear with 40 miles visibility, temperature 15 degrees and dewpoint 8 degrees winds 140 degrees at seven.

The 14,000 hour ATP had both an instrument rating and a military instrument examiner rating. He had 5000 hours remote bush flying, 4000+ hours sling load, 1500 hours in make and model and 1000 hours night flying. At 10:27 p.m. he radioed the hospital control base with an ETA of 55 minutes. At 10:59 he radioed his destination hospital and reported 20 minutes out from landing.

At 11:15 p.m. the helicopter impacted the ground in a right bank, descending attitude at 130 mph!

Witnesses reported seeing the helicopter between 100-400 feet with both navigation lights and search light on. The search light was intermittently lighting the partial fog as it flew over. They saw the helicopter heading toward the eventual crash site descending at a very shallow angle. The local fire department estimated ceilings at 300 feet at the accident site. The accident investigator estimated the conditions at the site to be overcast with the lowest ceiling at 100 feet.

RISK ANALYSIS

Pilot Factor:

The fact that he was obviously low and trying to navigate with his search light indicates, although he was aware of the deteriorating ceilings and patchy fog, that he obviously did not use good judgment in getting into it this far.

Aircraft Factor:

The aircraft had no apparent causal effect in this accident.

Environmental Factor:

The lack of weather reporting at the destination coupled with a VMC report from the nearest available reporting station lured the pilot into a false sense of security that led to a fatal decision.

Operational Factor:

The routine communication with both the control base and the destination hospital indicate that the pilot was both confident and comfortable with some very marginal, deteriorating ceilings.

HYPOTHESES

1. The pilot's experience with instrument and night flying and 1500 hours in the same make and model may have provided a false sense of invulnerability or the pilot may have developed a strong macho ("I can do it") attitude.

2. The motivation for completing this flight is not known. However, it is suspected that either the pilot had done this type of flying routinely of his own volition or he felt that this was expected or required by the air ambulance operator.

LESSONS LEARNED: Spatial disorientation is always a deadly risk associated with helicopter flight at any altitude. At night clouds and fog are difficult or impossible to see. The risk of spatial disorientation is two to three times greater. Extremely experienced, professional, instrument rated and night current pilots are no less susceptable to its insidious effect than are less experienced pilots. Spatial disorientation in helicopters at altitudes below 400 feet is almost always fatal.

Always be alert for possible unexpected weather when the location of the nearest reporting station is remote from your destination. f lower ceilings and/or poorer visibility than expected are encountered, assess the risk of continuing the operation as if your life depends on it (which it does, by the way) as opposed to the urgency of completing the flight as planned.

In the helicopter EMS industry, as in flying in general new people keep making the same old mistakes. If local weather phenomena, your operating rules, or your pride continually expose you to possible inadvertant IMC, you had better become proficient at instrument flying, or consider looking for another career.

PREVENTATIVE ACTIONS:

1. Even if you are not instrument rated, follow the suggestion of Advisory Circular 135-xx and practice instrument flying with a safety pilot or instructor as insurance against possible inadvertant IMC.

2. If you are instrument rated don't be complacent or overconfident in your ability. Do more than the minimum "6 and 6" required to stay current. Your life depends on it.

3. Don't succumb to the "it won't happen to me", invulnerability attitude. It <u>can</u> happen to you, it <u>does</u> happen to other pilots every year. Inadvertant IMC and the resultant spatial disorientation are the leading cause of all fatal accidents.

4. Beware of the macho hazardous attitude. If you continually find yourself thinking "Can do", counter that thought with the antidote: "Taking chances is foolish".

5. Develop and implement your own inflight risk management scheme. Set practical personal minimums and monitor every flight for the potential of encountering deteriorating conditions. Remember a successful flight is one that begins and ends with pilot, passengers and aircraft intact.

6. Develop and follow a training regimen as part of your operations manual. Discuss requirements vs abilities with your chief pilot and administrative personnel. If necessary point out the minimal cost of training compared to the cost of an accident. Use examples from this manual plus NTSB data to convince management that the type and amount of training required is necessary.

2.5 Spatial Disorientation -- Approach -- Night -- Fog

SUMMARY: A Part 135 air ambulance had completed an emergency medivac mission from an oil platform in the Gulf of Mexico to Jonesville, Louisiana. After dropping off the patient at 1:00 a.m. CST, the aircraft departed en route to its homebase at Quirksburg, Louisiana. While en route, the company dispatcher informed the crew that fog was moving into the area and they had better hurry.

About 10 miles out, the crew was forced to descend to 250 feet in order to maintain VFR. They set up a heading of 180 degrees to line up with the primary runway and began to visually search for the airport. As visibility and ceilings continued to deteriorate, the pilot asked the copilot to monitor the instruments while he continued to scan to obtain the runway environment.

The twin engine, IFR equipped, three million dollar helicopter impacted the ground in a level attitude about 300 yards short of the runway threshold. Instrument meteorological conditions prevailed at the airport at the time of the accident. Both crew members were instrument qualified and an ILS approach was available to runway 18, yet, no attempt was made to execute an instrument approach.

RISK ANALYSIS:

Pilot Factors:

1. Both crew members demonstrated poor judgment, risk assessment and risk management. They should have evaluated alternatives at the first mention of the possibility of fog by the dispatcher.

2. Once committed to complete the mission as planned, a bad decision was made in trying to maintain VFR. The decision to "duck under" rather that set up and fly the instrument approach just does not make sense. Beware of the anti-authority hazardous attitude. "Follow the rules, they are usually right" and they can prevent accidents.

Aircraft Factor:

The aircraft was not a causal factor in this accident, but it was capable of reducing the risk by virtue of its IFR certification and equipment.

Environmental Factor:

The type of fog encountered was typical for a coastal location during the early morning hours. The crew had probably completed this type of "VFR" approach many times since this was their home base. Both of these environment factors lured the pilots into a series of bad decisions.

Operational Factor:

The dispatcher contributed to a sense of urgency within the crew by suggesting that they had better hurry.

HYPOTHESES

1. The crew had apparently developed poor procedures due to laziness. Repeated successful outcomes to similar poor decisions may have reinforced their decision to continue VFR in IMC.

2. The comment by the dispatcher may be indicative of supervisory or administrative pressure to always get back to the home base. At the very least it influenced the outcome through peer pressure to "hurry up" and beat the fog.

LESSONS LEARNED:

The primary lesson to be learned from this accident is to resist the tendency to complete a flight as planned when circumstances change. The flight crew should have recognized that instrument meteorological conditions were probable and planned accordingly when first informed of the impending fog.

The second important lesson is not to become complacent about any approach even if it is to your home base and you have completed it successfully 1000 times before. Remember "you can make a difference" in balancing the risk elements of any flight.

Finally, if you do everything right and still get in over your head, be sure and use all available resources. Remember to climb, communicate and confess when encountering IMC. Above all, use your skills, instruments and available procedures to maintain the necessary level of safety.

PREVENTIVE ACTIONS:

1. Remember, safety equals situational awareness plus risk management. Develop and practice situation monitoring skills and risk assessment techniques. It has been proven that pilots with a high degree of situational awareness are safer pilots.

2. Study and practice the principles of good decision making. Do not succumb to peer pressure, management pressure or poor procedures (duck under) just to be a nice guy. Learn the antidotes to the impulsivity, invulnerability, and macho attitudes.

3. Use your aircraft, air traffic control and flight procedures to manage risks when they are encountered. Your life may depend on it.

4. Develop a personal checklist of key indications that would call for an alternative plan and then stick to it.

5. Obey the regulations, they have been designed and tailored to protect life and property. If local weather phenomena can be expected to cause IMC, discuss the need to practice instrument procedures at every opportunity with your chief pilot and administrators. Management, if this means letting pilots fly an ILS on a CAVU day, consider the extra time and cost involved as a small investment with a large potential payoff. To paraphrase an old adage: "If you think training is expensive, try having an accident!"

3.0 COLLISION WITH OBSTACLES

3.1 Wire Strike -- Night -- Takeoff -- VMC

SUMMARY: The twin-turbine power EMS helicopter responded to a call for transport of two critically injured auto accident victims. A company VFR flight plan was placed on file and takeoff from home base (a trauma center) was at about 0500 on a bright clear night. En route, the pilot was advised by fire department personnel at the accident scene to make his landing and takeoff to the south, which he did.

After the two accident victims, a paramedic and two flight nurses were safely aboard, the pilot performed a vertical, maximum performance takeoff. At approximately 75 to 100 feet above the ground, the pilot nosed over and began a transition to forward flight. As the aircraft reached 20-30 knots he suddenly saw two wires stretched across his flight path as they became illuminated by his searchlight. He pitched up and added power (collective) to avoid them. At that time a third wire, above the other two, came into view, but the pilot was unable to avoid it. The initial point of contact was below the nose near the front skid. The cable then became entangled in the tail rotor and momentarily tethered the helicopter before it broke. The tail rotor and 90-degree gearbox separated from the tailboom.

The pilot made an emergency landing by reducing both throttles to the engine idle stop to maintain directional control. The aircraft touched down hard, collapsing the skids and causing the tailboom to break off the fuselage. The pilot and paramedic sustained minor injuries but the others on board, including the two patients, were unharmed in the landing. Damage to the helicopter was classified as substantial.

RISK ANALYSIS

Pilot Factors:

1. The pilot, even though an experienced professional with over 4000 hours and an ATP rating, had only about 60 hours in this particular make and model helicopter.

2. He had no known medical or physical problems and had had five and a half hours of rest just prior to the flight.

3. He displayed a coolness and presence of mind in handling the aircraft after the wire strike that would indicate a good grasp of the concept of stress management.

4. No hazardous attitudes were evident, in fact the opposite was true with respect to several points. He applied the correct "antidotes" when he took the advice of the ground personnel rather than say "Don't tell me". When he used a vertical maximum performance takeoff technique he was admitting that "It could happen to me" and "Taking chances is foolish". Finally, once having had the wire strike, he resolved his problem as best he could, proving that he "was not helpless".

Aircraft Factors:

1. The helicopter had just about everything it needed to perform this mission. Two engines (adequate power reserve), skids, search light, EMS configuration, etc., as well as no mechanical, component, or systems failure or malfunction.

2. One (optional) piece of equipment was not installed - a wire strike protection system (WSPS).

Environmental Factors:

The weather at the time of the accident was VMC, a bright night, cloudless and with no restrictions to visibility.

Operational Factors:

The ground rescue personnel had some familiarity with helicopter operations and LZ control since they were able to advise the pilot as to the best landing/takeoff direction.

HYPOTHESES

1. Being night, albeit bright and clear VMC, it would have been practically impossible for anyone, either aboard the aircraft or on the ground, to see the wires high overhead until they were lit up by the helicopter's search light.

2. The pilot performed a vertical, maximum performance takeoff to an altitude of 75-100 feet AGL, which under most circumstances would provide an adequate margin of safety and obstacle clearance.

LESSONS LEARNED:

The pilot, in this case, did just about everything right. Yet he still found himself (and his crew and passengers) in difficulty. Nevertheless, once the wire strike had occurred, he maintained his poise and composure, followed procedures with skill (not to mention good headwork), and converted a potentially disasterous situation into a successful emergency landing.

Operations at night, particularly from unprepared and unfamiliar landing zones, the kind EMS pilots frequently encounter, require utmost caution and the widest possible margin of safety. Often, when lateral vision is obscured or obstructed, the only sure safe route out of a confined area may be straight up. Pilots who fly helicopters without a vertical takeoff capability when loaded to operational weight should consider the risks of confined area operations at night. Since the risks associated with such a situation cannot be changed, then it becomes necessary to modify the aircraft in terms of configuration, power available, protection and other safety systems and equipment, in order to provide every possible advantage under these conditions.

PREVENTATIVE ACTIONS:

1. One possible action would have been to wait until daylight to take off so that wires and other obstacles could be more easily seen and avoided. (Given the emergency nature of the situation, this clearly was not a viable option.)

2. Prior to landing, perform both a high and low recon procedure.

3. The installation of a wire strike protection system (WSPS) sometime prior to this mission might have prevented this accident.

3.2 Collision with Obstacle -- Day -- Takeoff -- VMC

SUMMARY: A single turbine powered helicopter was approaching the scene of an automobile accident in response to a call for an air ambulance. About one or two minutes away from landing, a radio call directed a diversion to a nearby hospital for the transport of a burn victim requiring specialized care. A portion of the hospital parking lot was secured by police cruisers as a landing zone. The helicopter circled the LZ before setting up an approach from the east. On short final, the pilot instructed the crew, two paramedics, to watch carefully, mentioning that the landing area looked "kinda tight". After an uneventful landing, the crew spent over an hour on the ground waiting while the hospital tried to find a burn center that would accept the patient. When one was finally located halfway across the state, the pilot realized that he did not have enough fuel. Accordingly, he decided to make an intermediate stop, while the patient was on board, to refuel at an airport along the way. While this practice is usually to be avoided, he considered it to be necessary in this case. After checking the patient securely loaded, the pilot made sure the area was clear and started the engine. Once up to speed, he exchanged a "thumbs-up" with the policemen who were standing by. The policeman in front gave hand-and-arm signals to lift and the helicopter began its ascent with a "quick but smooth motion", according to a witness.

Just as the helicopter began transition to forward flight, the main rotor struck an aluminum light pole, which had been about 65 feet in front and slightly to the right of the initial starting point. The point of contact on the 24 foot tall light fixture was about three feet from the top. The main rotor separated from the helicopter and the fuselage fell inverted to the asphalt parking surface at the base of the light pole. No post-crash fire or explosion occurred.

There were no injuries to persons on the ground. The pilot and the EMT in the aft facing right seat received fatal injuries. The EMT in the forward facing rear seat was seriously injured. Reportedly, the stretcher patient being transported did not sustain additional injuries as a result of the crash.

RISK ANALYSIS

Pilot Factors:

Since the pilot was fatally injured it is impossible to accurately assess what the pilot was thinking about prior to the accident or what possible hazardous attitudes on his part might have come into play as causal factors. His actions, and the experience of others in similar situations, give rise, however, to several hypothetical (probable) thought patterns that may explain them. See the hypotheses section.

Aircraft Factors:

There was essentially nothing wrong with the aircraft or its systems and it was therefore not a causal factor in this accident.

Environmental Factors:

1. As the pilot mentioned during the approach, the improvised heliport was "kinda tight".

2. The immediate obstacles (light poles) were very obvious and easily visible in the clear weather at that time of day.

3. Ground personnel (the police) were available to help clear the heliport.

Operational Factors:

1. There was no specific policy or guidance, either on a personal level or company-directed, specifying procedures for use in confined area operations.

2. The hospital had no established heliport and therefore had to resort to an impromtu landing zone for EMS helicopter operations. There was no way, therefore, to familiarize pilots with the LZ prior to the actual landing.

HYPOTHESES:

1. The pilot may have been concerned with his low fuel state and preoccupied with the expected refueling operation with the patient aboard at the next landing.

2. He (and the rest of the crew) were probably stressed by the frustration of being diverted at the last minute on their previous mission only to be made to wait over an hour on the ground to start the next.

3. Possible Hazardous Attitudes:

   Invulnerability - The pilot had obviously made many similar takeoffs in his career and may have been somewhat complacent.

   Macho - The pilot may have been "showing off" for the cops and emergency room medical crew on the ground.

4. Refueling with passengers aboard (the patient) is generally considered contrary to good helicopter safety practices and therefore was a probable source of concern (stress) for the pilot.

LESSONS LEARNED:

Even though this takeoff operation was more or less routine in just about every aspect, there was nevertheless a fatal accident. Most helicopter pilots naturally consider landing in a confined area to be more difficult than taking off, especially if the landing zone is unfamiliar. Having once gotten in, on the other hand, they consider it relatively easy to get out. As this accident illustrates, both phases are critical, and demand the pilot's undivided attention.

More often than not, pilots will find themselves faced with multiple decision situations. A good practice is to develop a systematic way to prioritize the decision making process as to level of importance and chronological order.

PREVENTATIVE ACTIONS:

1. The operator or the individual can develop and adhere to specific, well-thought-out, operational procedures for confined area operations, such as max performance vertical take offs.

2. Hospitals that anticipate any level of helicopter operations should establish designated (and well marked) heliports with adequate safety clearances and allow pilots to familiarize themselves on the ground prior to landing there.

3. Don't fall prey to the traps set by hazardous attitudes. Apply the proper antidote(s) if you find yourself thinking "It won't happen to me" or "I'll show them!".

4. Always pay attention to what you are doing!

3.3 Wire Strike -- Night -- En route -- Inadvertant IMC

SUMMARY: A truck accident victim was transported to the hospital via ground ambulance at 5:00 p.m. When the ambulance arrived, the on duty EMS pilot observed that the patients extensive head injuries suggested a high probability that he would need to be transported to one of the trauma centers 85 miles away. The pilot began preparing for the transport by checking the weather. Flight service reported "four hundred broken, seven hundred overcast, visibility a mile and a half, light drizzle and fog, forty seven's the temperature and forty six is the dew point." Although the weather had not changed from the previous hourly observation, both the pilot and the briefer expressed concern about further deterioration in ceilings. The forecast for the next twelve hours was six hundred overcast, five, in fog, occasionally ceilings up to a thousand. Since weather conditions at the departure showed greater than minimum flight visibilities for dispatch and ceilings and visibilities recorded by FSS at the destination were good, he made the decision to initiate the flight.

The patient was finally stabilized at 6:00 p.m. and the single engine, turbine helicopter was dispatched at 6:10 p.m. The pilot was flying a direct Loran-C course to his destination at 2200 feet MSL. Ground light references were inadequate so he adjusted his course of flight to remain closer to horizon light references along a known highway. The highest terrain and point of the most probable weather problem was straight ahead at an elevation of 1300'. As he approached this terrain he was at 2000 feet but "wisps of clouds were beginning to come by and the rain increased". The clouds sloped down and away so he began a slow deceleration and descent to remain clear of clouds. The weather conditions grew worse as the aircraft crested a hill and encountered level terrain. The pilot then made the decision to return the patient to the nearest hospital for ground transport.

The pilot had just initiated a right hand turn when the helicopter struck powerlines. He had inadvertantly tried to fly between the 53' high phase line and a 66' high static line. The pilot stated "I believed us to be considerably higher above the ground than we obviously were as we struck the wire at that instant. The aircraft pitched violently nose down and it was spinning wildly out of control. I knew full well that we were crashing and simply tried to kept the aircraft upright".

Observations of a surviving paramedic: "The pilot landed the aircraft on its skids, which was a feat in itself. The weather was a consideration as we flew the mission and talked about how long it would take to get an ambulance if we were to continue by ground."

"I would, in the same circumstances, fly as we did that night, without concern. I feel that the pilot acted very cautiously in this situation and have no reservations about his capabilities or his judgment."

RISK ANALYSIS

Pilot Factors:

1. Although his flight preparation (two weather briefings) and inflight decision making was generally good, his launch decision was based on standard dispatch minimums rather than yielding to his expressed concern "that dewpoint/temperature spread scares me" and the FSS briefers statement that "it kind of looks like we keep getting worse".

2. The pilot failed to recognize the bad decision chain and break it even though he was actively assessing the risks and monitoring the situation. For example, he could have turned around when he first started losing the horizon, when he discussed getting a ground transport with the paramedic, or when he first encountered the "wisps" of clouds.

Aircraft Factor:

The aircraft was not a factor in this accident.

Environmental Factor:

The deteriorating ceilings certainly played a leading part in this accident. However, the message did not get through strongly enough to the pilot even though his awareness of the situation was fairly good.

Operational Factors:

1. The criticality of the patient as observed by the pilot undoubtedly influenced the go/no-go decision as well as the decision to continue the flight in deteriorating weather conditions.

2. When assessing the alternative of a ground transport from an intermediate hospital, the pilots risk assessment was again influenced by the criticality of the patient, the fact that it would take 45 minutes or more to get a ground ambulance to the hospital and by the lack of enthusiasm or support for this safe decision by the paramedic. He just didn't know how long it would take.

HYPOTHESES:

The pilot may have been looking for peer support when he frequently vocalized his concerns about having to turn back, looking for a rest stop, etc. The paramedics lack of support left the pilot on his own, so to speak. The pilot was thus falling prey to a form of the "resignation" hazardous attitude by looking for others to make his decision for him..

LESSONS LEARNED:

Trying to maneuver and maintain visual contact in deteriorating weather is an invitation to disaster. This pilot was experienced, instrument trained and qualified. However, in the process of trying to maintain situational awareness, assess the risk of continuing flight, maintain visual contact with the lights on a highway, fly the aircraft, and worry about the criticality of the patient, he lost a critical piece of information -- altitude awareness.

However, even though the flight was launched in greater minimum visibilities than required, and was headed for visibilities and ceilings reported as safe by FSS, once he began a decelerating descent, the pilot was scud running. The flight ended in IMC, fortunately with two survivors. However, the patient was a fatality in the accident so the advantages of expediency and speed offered by the helicopter were ultimately lost.

Taking chances is foolish under any circumstances. Exposing two more lives to potential peril is never acceptable. Always look and listen for that first link in the chain of errors. If something doesn't look right, or if your basic concerns about decreasing ceilings are found to be correct, take a safe alternative action before the situation exceeds your ability to cope with it.

PREVENTATIVE ACTIONS:

1. Do not fly in conditions such as reported here. Four hundred foot ceilings are not acceptable operational minima for night cross country (greater than 25nm) flights. An FAA Advisory Circular recommends 1000 feet and 3 mile minimums and these are supported by an industry consensus.

2. A 180 degree turn does not guarantee a return to visual conditions and is one of the surest ways to induce vertigo or spatial disorientation. Why not go IFR if you are caught in IMC. Your conditioned response should be to "climb, control, communicate, confess and comply". That is get away from wires, obstacles and terrain. Contact ATC and adhere to their instructions.

3. Develop and coordinate a procedure for inadvertant IMC with your local flight standards office and local air traffic control facility that has jurisdiction over your area of operations.

4. And remember "If you don't want to get eaten by sharks, stay out of the water". That is don't fly in weather that could be life threatening and never fly below the light stanchions or antenna heights in your zeal to complete a mission or get the job done.

3.4 Tree Strike -- En route -- Night -- Creeping IMC

SUMMARY: The on-demand air taxi operator received a call from dispatch at 10:20 p.m. to fly to another hospital to pick up a patient with a subdural hematoma. The pilot called flight service for weather and received a VMC report.

> "2,000 broken and higher decks with 7 miles visibility occasionally 2,000 broken with 4 miles rain and fog with a chance of 500 feet and 1/2 mile with heavy rain showers."

The pilot departed the hospital helipad about 10 minutes later for his 50 minute outbound leg. En route the ceiling was as reported and visibility was 10-15 miles. He observed rain areas along his route of flight. He requested that the nurse and paramedic limit the ground time to load the patient and expressed concern about the weather. He told the crew that they might have to make a change in plans should the conditions worsen. He landed at the patient referring hospital at 11:21 p.m.

After stabilization of the patient was complete the helicopter departed at 11:55 p.m. and climbed to 1500 feet MSL for the return leg. About 8 minutes out the pilot encountered a wall of thundershowers and fog. There was no ceiling. They diverted east around the storm in good weather.

Several minutes after resuming a northerly heading they encountered another wall, descended to 1000 feet and headed east again. After getting around this wall and heading north again, they encountered a third wall. The pilot radioed flight service and was advised he could possibly make it around the thunderstorm. At about the same time he spotted the city lights of his destination, the rain greatly diminished and adequate ground references became visible. A left hand turn was initiated when suddenly everything appeared blackened and the flight paramedic shouted "Francis, I can see trees, we're too low, get us up, get us up!"

The pilot initiated a climbing left turn just as the helicopter struck a tree. The right chin bubble was broken and the right door was torn off by the impact. The pilot then climbed to about 700 feet, located a landing area, landed and the patient and crew were transported by a ground ambulance.

RISK ANALYSIS

Pilot Factors:

1. Pilots are goal oriented individuals with a drive to please people and complete the mission as planned. The pilot was skilled and tried to manage the weather risk. In the process he obviously lost altitude awareness.

2. The pilot did not properly respond to repeated encounters with severe thunderstorm activity (chain of errors) and lured himself into danger by bypassing potential landing sites he had spotted.

Aircraft Factor:

The aircraft was not a factor in this case.

Environmental Factor:

The forecast of a chance of 500 feet and 1/2 mile with heavy rain was overly optimistic. The basic weather was marginal VMC at best. The accident occurred in IMC.

Operational Factor:

The pilots stress level was obviously high since first, he knew the seriousness of the patient and second, was very concerned about the weather, groundtime etc.

HYPOTHESES:

1. The pilot was probably so preoccupied with maintaining VMC, communications, etc that his instrument scan and aircraft control skills deteriorated.

2. The amount of supervisory, administrative and/or physician pressure to complete this mission is unknown, but it is suspected that some factors were influencing the pilot to continue to dodge thunderstorms rather than set the helicopter down and transport the patient by ground ambulance.

LESSONS LEARNED: The pilot, aeromedical crew and patient were very fortunate in this instance because the paramedic happened to look out the passenger window and notice the trees. However, EMS flights cannot be planned based upon happenstance. Basically, three lessons are to be learned from this accident. First, although the weather report was VMC, the chance of 500 feet and 1/2 mile in fog should have alerted the pilot to the point of making a commitment to alternative ground ambulance transport when he first encountered deteriorating weather.

Second, weather reporting and forecasting is an inexact science at best which suffers from a lack of sufficient observation/reporting sites, frequency of observations and currency of reports. Pilots must learn the vagaries of local phenomena and be alerted by, and respond to, key elements of a report. A go/no-go decision should not be made by chance, as in "chance of fog". A 1-3 degree spread in temperature dewpoint should alert the pilot that the risk associated with the flight has just doubled or possibly tripled. Develop your own rules of thumb and personal minima and abide by them.

Third, the major elements that differentiate good judgment from pilot error are situational awareness and risk management. Situational awareness is the accurate perception of the factors and conditions that affect the aircraft and the flight crew during a specific period of time. Risk management includes recognizing escalating risks, assessing alternatives and responding to them in a manner that produces a safe outcome.

PREVENTATIVE ACTIONS:

1. Listen to, and carefully evaluate, the entire weather briefing. Do not focus on the positive or optimistic parts you want to hear i.e. VMC conditions. Balance your desire to make the flight with the risk to personnel and aircraft. Always ask the question: Could this transport be done safer by ground ambulance?

2. Do not overestimate your abilities or develop the invulnerable attitude. It can happen to you!

3. Develop an alertness to the poor judgment chain. Whenever an unexpected or unplanned change occurs during a flight, carefully assess the impact on the risk of continuing as planned. Evaluate alternatives and respond to your evaluation by acting to reduce risk and improve the safety of flight.

4. If your operation or the local environment necessitates flying in marginal VMC, reduce the risk by the installation and use of aids such as an autopilot, weather radar and/or a radar altimeter.

3.5 Wire Strike -- Day -- Takeoff -- VMC

SUMMARY: The single turbine powered EMS helicopter had landed about midday to pick up a critically injured auto accident victim. Prior to landing, the pilot performed an aerial reconnaissance of the site. Since the winds were calm, he elected to land on the road so that the patient loading door would be facing the accident. After landing, the flight nurses went to stabilize the patient for transport and the pilot frictioned down the controls and, without shutting down, got out to open the side door for loading. Before getting back into the helicopter, the pilot "made a scan" (his words) from in front to determine the best departure route.

In front of the landing site the road curved gradually to the left. On either side of the road were telephone and power lines. Traffic was backed up in both directions as a result of the accident and the necessity to clear a space for landing. The pilot reported that he did not see any obstructions to the west (his intended direction of departure) other than the heavy telephone poles on both sides of the road.

When the patient and crew were aboard, the pilot announced that he was taking off, and did so. On climbout, the pilot followed the road curvature, overflying the stopped traffic; within 10-15 seconds of lift-off, the helicopter struck a wire stretched across the road perpendicular to the line of flight. The initial point of contact was on the engine nacelle. The wire travelled upward and, after breaking, wrapped itself around the rotor mast. The pitch control links separated and the pilot lost collective and cyclic control. The helicopter pitched nose up, descended and struck the roof of one of the stopped cars in the road. This caused the aircraft to roll right and strike an embankment on the side of the road. There was a small post-crash grass fire that was quickly extinquished by firemen on the scene.

Both flight nurses had been attending the patient during the takeoff and were not strapped in. Consequently, one flight nurse, and the pilot, sustained serious injuries in the crash. Fortunately, the other flight nurse received only minor injuries. The patient/passenger was not further injured, nor were any bystanders on the ground. The helicopter was demolished.

RISK ANALYSIS

Pilot Factors:

1. The pilot was a very experienced professional with over ten thousand total helicopter flight hours and over six hundred in this make and model. He held a valid Class II Medical Certificate with no waivers or limitations and had had a Biennial Flight Review only one month before. As far as can be determined, he was not suffering any undue physical or mental stress at the time of the accident.

2. While the pilot did use both his seat belt and shoulder harness he did not insist that his crew - the two flight nurses - use theirs. There evidently was no pre-takeoff checklist (call and response) used, at least with regard to crew security.

Aircraft Factor:

The aircraft and its systems were functioning properly and, therefore, not a causal factor in this accident.

Environmental Factors:

1. By its very nature, the landing site of any on-scene pick up will be a source of many potential dangers. There was certainly nothing to indicate that this particular one was any different. In fact, telephone poles running on both sides of a road would strongly suggest the likelihood of wires being stretched between them across the road.

2. The weather was clear and calm at the time - no factor.

Operational Factors:

1. There was no specific policy, procedure or guidance, either personal (on the part of the pilot himself) or company directed, for confined area operations.

2. A takeoff and climbout path that takes an aircraft over people, in this case the line of backed up traffic in the road ahead, needlessly exposes them to danger and is therefore specifically prohibited in the FAR's.

3. No operational priorities were established with regard to the relationship between medical needs of embarked patients and aviation safety.

HYPOTHESES:

1. Because the pilot had so much flight experience in helicopters, he may have been somewhat complacent about his ability to handle various situations as they arise. This supposition is supported by his own admission to only a cursory "scan" of the proposed route of departure prior to takeoff.

2. Possible hazardous attitudes:

   Invulnerability - The pilot evidently simply denied to himself the possibility that there may be wires stretched across the road.

   Resignation - The pilot may have felt that since the nurses would insist that their need to attend the patient superceded his requirement that they be strapped in, he could not (or should not) compel them to do so.

   Macho - In making the "dramatic" departure, sweeping over the line of backed up traffic, the pilot may have been (unconsciously) making a "grandstand play" or showing off.

LESSONS LEARNED:

1. The lesson to be learned here seems destined to be relearned over and over again - each time the hard way. Landing and taking off at an unprepared, or hastily prepared site is always going to offer a potential for problems. Extreme caution is called for in all such situations. A successful arrival in a confined area does not guarantee a successful departure. There are really only two directions from a landing site that practically assure clearance from unseen wires and other hidden obstacles: the way you came in and straight up. If they happen to coincide, then the number of safe routes is reduced to one. Even then, there is always the possibility that you were just lucky and missed hitting the wire on your approach that could get you on your departure.

2. If you are in an aircraft accident, the safest thing to be is as much a part of the aircraft as possible. In other words, strap yourself in - particularly during takeoff and landing. Otherwise, in the event of a crash, you will become a "UFO" (unrestrained flying object) in the cabin, which will probably result in injury to yourself and to any others with you.

PREVENTATIVE ACTIONS:

1. At an unprepared and/or unfamiliar landing site, if at all possible prior to takeoff, walk the intended line of flight to spot wires or other hard-to-see obstacles.

2. A vertical or nearly vertical takeoff, if ambient conditions, power available and load permit, to a level above the highest possible obstruction is generally the safest departure route from a confined or unprepared area.

3. Always use the appropriate safety restraint devices provided in the aircraft (seat belt and shoulder harness, if available) and absolutely insist that crew and passengers do also. If the aircraft being used is so configured that flight nurses cannot attend patients and remain strapped in, consider reconfiguring the aircraft or getting another type.

4. On takeoff, avoid overflight of people, vehicles, and other aircraft (as required by FAR Parts 91 and others) if at all possible.

3.6 Terrain Strike -- Day -- En route -- Rolling Fog

SUMMARY: A late model, twin turbine helicopter crashed into the side of a mountain 1000 feet below the last recorded radar altitude. The Part 135 aircraft had been dispatched at 12:22 p.m. EDT on an emergency medical transport to pick up a patient with subcranial bleeding at a hospital 56 miles to the northwest and transport him back to their base hospital.

A weather briefing was obtained by the pilot at 7:40 a.m. from the Flight Service Station located 66 miles due south of the destination. Widespread IMC was predominant and VFR flight was not recommended at that time. However, the surface observation recorded at 11:45 a.m. by the local tower (at the departure city) was 1500 feet scattered cloud cover with three miles surface visibility. The temperature was 72 degrees F with a dew point of 67 degrees F.

Several position and patient information reports were communicated between the helicopter and central dispatch. The pilot was able to monitor the transmissions between the hospital and the on-board flight nurse.

Within 12 miles (6 minutes) of his destination, the pilot made his last position report. Impact occurred less than 60 seconds later. Witnesses 1 mile from the crash site heard a "thud" but could not see anything due to fog that had been rolling in and out of the area all morning. About 30 minutes after the sound of the crash the mountain was clear. A commercially rated pilot living at the base of the mountain observed the weather to be solid overcast, about 3400 feet m.s.l. with visibility 3-5 miles due to haze. He cancelled his own planned flight.

RISK ANALYSIS

Pilot Factors:

a. Two minutes out the pilot was offered radar advisory service. He acknowledged, but did not request.

b. He was not current or qualified to operate under IFR.

c. He was either insufficiently familiar with local weather phenomena or did not monitor the situation adequately.

Aircraft Factor:

The aircraft was not an casual factor in this accident (see hypotheses).

Environmental Factor:

Local morning ground fog had not completely dissipated at the crash site although reported weather at departure location was VMC.

Operational Factors:

The fact that the pilot knew of the seriousness of the patient's condition and was able to monitor communications between the flight nurse and the nospital contributed both a distraction factor and a sense of urgency to complete the flight as planned.

HYPOTHESES:

Maintenance Factor. (Possible) Autopilot components had been removed & replaced by the component manufacturer representative without entering alterations in the aircraft records. Chief pilot reported autopilot had been operating properly since the component change.

Improper stress management, risk assessment and an "I can do it" (Macho) attitude are likely contributors.

LESSONS LEARNED: Even a properly planned flight in a well equipped twin engine helicopter by experienced, professional pilot can become an inferno of flaming wreckage in less than 60 seconds. Inadvertant IMC, spatial disorientation and a gradual descent of only 1000 feet were the lethal chain of events which caused this accident. Whether the autopilot was engaged and/or functioning is not known. But if it was on, it was not in the altitude hold mode.

The fog that was rolling over the peak "like a waterfall" was certainly the primary cause of this accident. However, it is ultimately the pilot's responsibility to insure the safety of flight, properly assess deteriorating conditions and have a planned course of alternative actions when unexpected changes occur during a flight.

PREVENTATIVE ACTIONS:

1. Develop and utilize supplemental training in recovery from inadvertant IMC.

2. Additional pilot training for familiarization with regional weather phenomena, local area terrain hazards and minimum operating altitudes should be conducted whenever possible.

3. Insulate the pilot from specific knowledge about the criticality of the mission or the condition of the patients.

4. Learn to identify and avoid the MACHO hazardous attitude, ("It won't happen to me") and instill the positive attitude that taking life threatening chances in any operation is always foolish.

3.7 Collision with Obstacle -- Day -- Takeoff -- VMC

SUMMARY: A single turbine powered EMS helicopter was parked on a ramp extension at a third story rooftop hospital heliport. The parking ramp, which measured sixty feet long but only twelve feet wide, had an eight to eighteen inch high concrete curb or parapet around three sides of it. The curb had originally supported a fence that had since been removed to facilitate helicopter operations. The attachment bolts remained, however, protruding about two inches up from the concrete curb at eight foot intervals.

A pilot and two flight nurses were aboard for a flight to pick up a stroke victim. The helicopter lifted from its parking position with a five knot left crosswind blowing. Suddenly it rolled, or "tilted", to the right. A snow pad installed on the bottom of the right skid had collided with one of the bolts on the curb. This was followed by a loud snap and a lurch further to the right. The helicopter accelerated rapidly sideways toward the main hospital superstructure adjacent to the helipad. As the pilot struggled to recover and to avoid hitting the building, the nose pitched up and the tail rotor impacted the deck (roof surface) between the ramp and the building. The helicopter entered a spin to the right, making two or three complete revolutions before coming to rest in an upright position on the edge of the helipad. The pilot then shut down the engine.

The left and right skids had been torn from the helicopter and the bottom of the fuselage was substantially damaged. The downward flexing main rotor blades were damaged as they severed the tail boom just aft of the horizontal stabilizer. The left windshield and both chin bubbles were broken out. There was no post-crash fire. Neither the pilot nor the flight nurses aboard sustained any injuries.

RISK ANALYSIS

Pilot Factors:

1. The pilot was an experienced professional with almost 5000 hours total flight time and 3500 in rotorcraft. He had no apparent medical or physical problems and was adequately rested prior to the accident.

2. The pilot stated that after he had lost tailrotor effectiveness as a result of the impact with the roof deck, he maneuvered the spinning helicopter away from the hospital building and onto the helipad before retarding the throttle to arrest the torque. He combined skills and procedures with good headwork in response to a radical change in normal situation to prevent a possibly much worse result in terms of damage and injuries.

Aircraft Factors:

1. Weight and balance calculations indicate that the helicopter would have been at or near maximum gross weight as configured with a patient aboard.

2. Hard landings and/or continued operations at high gross weights will naturally cause skids to spread farther apart than normal. A maximum of two inches on either side is permissable. This helicopter also had 24 inch wide snow pads installed, so with maximum allowable spread the skids could have had a tread base in access of 10 feet wide.

Environmental Factors:

1. The parking space, confined on both sides by a concrete curb or wall, was only twelve feet wide and was used to accommodate a helicopter with a skid tread width of ten feet or more. This does not allow much margin for safety, either in a figurative or literal sense.

2. The weather, at the time of the accident, was cool and clear (VMC) with a light wind blowing from the west.

Operational Factors:

1. There was no flight plan filed for this trip with either the FAA, the company or hospital operations.

2. By its very nature, a rooftop heliport offers little, if any, extra space for helicopter parking. This is particularly true if there is a requirement to maintain the landing area open for other helicopters. In this case there was an auxilary ground level heliport available about a half mile away. But it was not used because the necessary ground transportation access link created delays in response time.

HYPOTHESES:

1. The manner in which he handled the helicopter after contacting the curb would indicate an exceptional ability on the part of the pilot and a presence of mind that would tend to offset the apparent carelessness in allowing the skid to "trip" over the curb in the first place.

2. It would be difficult to find fault in overlooking the exposed bolts in the rampside curb as a potential aviation hazard. After all, had the helicopter been hovering only two inches higher, the accident would never have happened. However, risk management, like baseball, can be a matter of inches. An accident did occur as a result of the bolts being left in place. Since they also presented other hazards to ground personnel, etc., prudence and good risk management techniques should have dictated their removal. Certainly, the yield, in terms of safety benefits, would have more than offset the relatively low costs of the hacksaw job.

3. To most pilots, the weather conditions at the time of the accident would not be a cause for alarm. But, the helicopter was parked in a narrow defile, with less than a foot skid clearance on either side, facing north. Winds from the west meant a direct crosswind, albeit light, was blowing at takeoff.

4. The fact that no flight plan was filed may not be unusual, but it may also indicate a certain lack of preflight forethought - a kind of "kick the tires, light the fires" inclination on the part of the pilot.

LESSONS LEARNED:

Situational awareness is the key to good decision making. In this specific case the four basic risk elements that comprise "the situation", as defined in Chapter Two, have been reviewed and analyzed. Each, in itself, is not a particularly dangerous condition, ie: bolts sticking two inches up from a foot-high concrete curb, a light (5 kts) crosswind, and a helicopter at or near max gross weight. The synergistic effect of these conditions taken together, however, produce a greater (more dangerous) total effect on the situation than the sum of their individual effects. The result was an accident in which a helicopter was substantially damaged.

PREVENTATIVE ACTIONS:

1. If any one of the three conditions mentioned above (the bolts, the wind, and the high operational weight of the helicopter) had been modified or eliminated, this accident probably would not have occurred. Obviously, not much can be done about the wind. The equipment and other operational requirements associated with the EMS mission pretty much predetermine the operating weight of the machine at takeoff. But something could have, and should have, been done about the exposed bolts. (In fact, they were removed subsequent to the accident.)

2. A heightened situational awareness on the part of the pilot, or on the part of the operator of the heliport (ie: the hospital administration), might have caused a modification in policy or procedures in response to that situation. For example the pilot could have simply paid a little more attention to the takeoff maneuver and adjusted his control inputs to compensate for the effects of wind and the configuration of the heliport (environmental risk factors) and his operating weight (aircraft risk factor). Also, the helicopter might have been parked at the (less convenient but probably safer) auxilary ground level heliport. Any one of these actions would also have prevented this accident.

3.8 Collision with Obstacle -- Night -- Takeoff -- VMC

SUMMARY: A single turbine powered helicopter, configured for air-ambulance service, was involved in Search and Rescue (SAR) operations in connection with an airplane crash. The crash site was in heavily wooded mountainous terrain and remote from any nearby "civilization". The SAR operation was being being conducted by the county sheriff and was assisted by another "Mountain Rescue" helicopter. Both helicopters had landed at dusk on a ridgeline about a quarter mile distant from the crash site and the crews had hiked downhill searching for wreckage and survivors. Two badly burned victims were located. After appropriate first aid treatment, it was decided that they required immediate transport to a hospital.

It took the entire crews of both helicopters, including the pilots, to move the victims back uphill as they were both big men (200+ and 300+ pounders). A great deal of physical effort was necessary to transport and load the patients just prior to takeoff. It was almost midnight before they were ready to go. Two deputy sheriffs volunteered to remain behind in order to lighten the load. But the pilot, after checking the weight and balance, decided that would not be necessary. A hover check that required only 85% torque seemed to confirm the pilots calculations. However, as the pilot pulled 100% torque in his attempt to takeoff into the wind, over a 50-75 foot distant low tree line, the EGT (Exhaust Gas Temperature) went thirty degrees over redline. He descended back to a low hover and noted that the wind seemed light. He decided to do a 180-degree pedal turn and depart downwind, which offered less obstacles in his path. Immediately after the turn, as he applied power for departure, the pilot "lost visual reference with the ground" and found himself actually flying backwards. The tailrotor contacted a tree, the helicopter fell, rolled downhill and came to rest against some trees.

Fortunately, all on-board sustained only minor injuries, but the helicopter was destroyed. The survivors were forced to spend a cold night on the mountainside and were picked up the next morning.

RISK ANALYSIS

Pilot Factors:

1. The pilot had been on duty for 16 hours (1.5 hours of flight time) at the time of the accident. Just prior to takeoff, the pilot had been involved in carrying the heavy patient uphill to the LZ.

2. The pilot had a limitation on his medical certificate requiring him to wear glasses for "distant vision".

3. The pilot had been told by one of the paramedics that she did not think the patient, a burn victim, would survive the night on the mountain.

4. The pilot had relatively little night flying experience - less than 5% of his total time. At the suggestion of making two trips to remove everyone from the mountain, he stated that he "wasn't crazy about the idea" of landing again at that LZ in the dark.

5. The pilot had also mentioned that he was upset at having to do SAR (search and rescue) work, as opposed to emergency medical transport which he considered to be their true mission.

Aircraft Factors;

1. The pilot had calculated that the load was within limits for takeoff. The hover check required only 85% torque, but as he pulled pitch the EGT spiked over the redline.

2. The pilot was aware of a possible bleed air engine deicing system malfunction (that would tend to cause the EGT to overtemp) because he had experienced intermittent problems on previous flights.

Environmental Factors:

1. The night was dark without much ambient light up in the mountains. The weather was basically VMC with intermittent rain showers in the area and wind was light and variable.

2. The LZ was in an unprepared confined area on a heavily wooded ridgeline There was only one clear approach/departure path.

Operational Factors:

1. The pilot had been told by the attending paramedic that she did not think the airplane accident victim, who had been burned, could survive the night in the woods without proper medical attention.

2. The pilot considered medical transport to be the primary mission of the helicopter and crew and consequently felt unprepared for search and rescue work.

HYPOTHESES:

The pilot was considerably stressed by several of the above mentioned factors Specifically, he must have been suffering from physical stressors (the cold, reduced visibility in the dark, lateral acceleration forces during the pedal turn - inner ear problems, etc.), physiological stressors (fatigue, less than perfect eyesight, hunger, etc.) and psychological stressors (concern for the patient, anger at being "roped into" doing SAR work, etc.). Any or all of these were sources of severe distraction and could have contributed to the development of a case of vertigo on takeoff.

LESSONS LEARNED:

To put it bluntly, this guy was an accident looking for a place to happen. The "margin of safety" as depicted in Figure 1, was nonexistent due to extreme increase in the task requirements over the normal situation exacerbated by severe reductions in pilot capabilities.

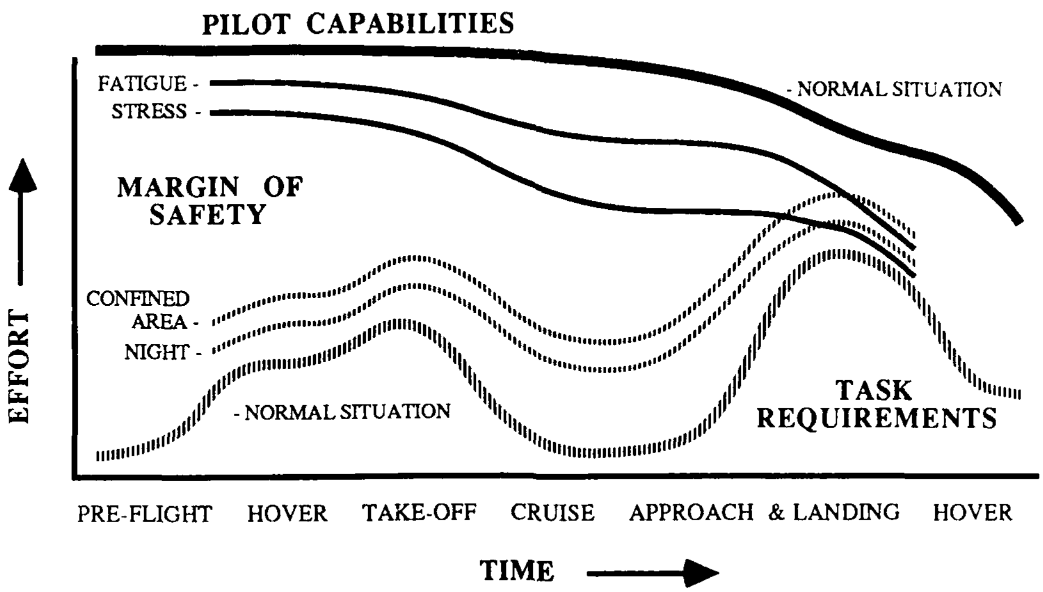

FIGURE 1

Pilots need to learn how to recognize and be aware of the effects of stressors and other factors in any given situation that tend to reduce capabilities and/or increase workload. Good decisions will generally be the result of adjustments and alternatives selected accordingly.

PREVENTATIVE ACTIONS:

It is only natural to want to get the job done, particularly if human life is at stake. But it is senseless to put several lives to inordinate risk for the sake of one. It may often seem heartless or cruel, but the best aeronautical decision may be not to fly at all. (It is ironic to note that the accident victim in this case did survive the night in the woods after all, despite having been in a second aircraft crash.)

4.0 POWERPLANT ACCIDENTS

4.1 Failed Autorotation -- Night -- Approach -- VMC

SUMMARY: The call for an air ambulance patient transfer came at about 3:30 a.m. The helicopter departed Dullsville at approximately 3:45 a.m. with a pilot and two nurses en route to Ham County Hospital. The en route flight was routine and lasted approximately 35 minutes. Weather was clear, visibility 15 miles, temperature 15 degrees F, dew point 11 degrees F, wind 180 at 12 knots, altimeter 29.85.

At 0415, the pilot radioed that he was nearing his destination. Shortly thereafter, the helicopter was seen by ground ambulance personnel. It was approaching the hospital area from the south. The helicopter passed to the west of the parking lot and circled the hospital to the right. During the circle, the pilot advised that he would land from south to north (downwind).

Witnesses said the approach looked normal until the helicopter was at 250 to 300 feet altitude and 150 to 200 yards from the hospital parking lot (landing site). It was dropping and slowing its forward speed at a normal rate when the helicopter nosed up sharply and then dropped forward at about a 45-60 degree angle and came down at a high rate of speed. Just before impact, the aircraft again changed attitude with a nose up flare.

The aircraft impacted the ground in a level attitude with little or no forward movement and with a high vertical velocity. The damage present in the main and tail rotors indicated very low rpm upon impact i.e., only two of the three main rotor blades struck a power pole guy wire which extended through the main rotor arc and only one tail rotor blade had strike damage from hitting the ground.

The engine ran for a few minutes after impact. There were no survivors.

RISK ANALYSIS:

Pilot Factor:

A power loss at 250 to 300 feet during a stabilized approach need not result in a fatal accident. Since the pilot was pointed straight at the desired landing spot, a survivable autorotation could have been possible. This would require early recognition of the failure, a quick response and being trained and proficient in performing autorotations.

Aircraft Factor:

Post crash tests of the engine, fuel control systems, fuel pumps, etc. revealed no pre-impact failure or malfunction. A fuel control malfunction was suspected as "most likely", but there was no real evidence to support that theory. Power loss for undetermined reasons is listed as the probable cause.

Environmental Factor:

An approach to a lighted parking lot with snow piles cluttering the LZ increased both the actual and perceived risk.

Operational Factor:

Autorotation training and currency is a critical element of any overall risk reduction program.

HYPOTHESES:

Since the pilot was relatively "low time" - less than 2500 hours total and 250 hours in this make and model - his experience with autorotations, both real and practice, was proportionally limited. It is therefore quite probable that his response to the sudden low power condition on short final at night was simply inadequate to successfully cope with the emergency situation. He either failed to unload the rotor (down collective) soon enough or he flared (aft cyclic) too soon, or both, and "ran out of rotor RPM" before he ran out of altitude.

LESSONS LEARNED:

The exact reasons for deciding to land from the south (downwind) are not known. However, if the pilot had considered a possible power loss and the reduced chances for a safe autorotation, he probably would have chosen differently.

Beware of complacency and overconfidence due to familiarity of the environment or confidence in equipment. It can happen to you.

Do not underestimate the importance of training and proficiency in autorotations. Consider the cost of one hour per month practicing autorotations vs the cost of a totaled helicopter and 3 lives.

PREVENTATIVE ACTIONS:

1. Aeronautical decision making teaches that there are three mental processes of safe flight: automatic reaction, problem resolving and repeated reviewing. This accident could have been prevented by the correct automatic reaction and precise aircraft control.

2. There are three answers to this pilots dilemma: training, training and training. The need for actual flight training is basic and continuing. However, there are also an increased number of options (accident scenarios) available through simulator training. Evaluate the costs in time and dollars and work out a practical plan to improve safety in your operation.

3. Pilots normally have no authority in deciding the frequency of non-standard maneuver training. The vendor and program administrator should include the time and cost in the initial contract and the standard operational procedures.

4. Pilots must constantly be aware of the possibility of total power loss and should perform each approach with all other factors, e.g. wind direction, in their favor.

4.2 Mechanical Failure -- Day -- En route -- VMC

SUMMARY: The twin turbine EMS helicopter departed the major metropolitan hospital on a trip over the mountains to pick up a patient in a city some distance away. The ambulance configured machine, with a pilot, paramedic and flight nurse aboard, was at maximum gross weight at takeoff. The weather was clear and cool; the winds were light.

Just after takeoff, an airport lineman who had serviced this particular helicopter in the past and was familiar with it, happened to be driving near the hospital and observed the machine as it passed overhead just after takeoff. He noticed that the left engine cowling door was wide open. The flight path of the helicopter next took it over the local airport at 1500 feet above ground level. After it had passed over, ground control received a call stating that "something had fallen from the sky and almost struck an airplane waiting at the runway hold short line". Investigation revealed that it was the engine cowling door with the hospital and the flight program's name painted on it. The two hinges were intact with torn metal from the cowling still attached. The latches were in the locked position, undamaged, and the inside insulation was scorched.

The helicopter continued into a mountainous area and disappeared from radar without any communication. Shortly thereafter, black smoke was observed in the mountains in the direction of the helicopter's last known position. Approximately eighteen minutes into the flight, the helicopter had crashed in mountainous terrain 14 miles from the airport at about the 4200 foot level. It had impacted nose high on the slope of a boulder strewn bowl-shaped depression. There was a good landing area only a short distance from the crash site, but 300 feet higher. The heading at impact indicated that the pilot had turned back (downhill) toward the general direction of the airport. The helicopter was totally demolished and the pilot and crew all received fatal injuries in the crash.

RISK ANALYSIS

Pilot Factors:

1. The pilot was a highly qualified (ATP Rating) and experienced (over 5000 flight hours) professional.

2. There was no evidence or indication of a medical or physiological problem on the day of the accident. He was adequately rested, he was only 5 hours into the shift (duty period) after having had 4 days off.

Aircraft Factors:

1. There were no discrepancies or problems written up in the aircraft maintenance records regarding the engine cowling doors or their latches prior to this flight.

2. There was a six month old "maintenance carry-over discrepancy" reporting the No. 1 engine torque transmitter as being inoperative. This discrepancy was not cleared by any subsequent log book entry. However, a maintenance test pilot stated that the No. 1 torquemeter was functioning normally on a flight the day before the accident.

3. Using the helicopter's empty weight, the actual weight of the three occupants and the on-board fuel and oil weight at takeoff, the gross weight was determined to be 5,069 pounds. The maximum allowable gross weight for this model of helicopter is 5,070 pounds.

Environmental Factors:

1. The weather at the time of the accident was clear and cool. No factor.

2. All communication, navigation, and surveillance facilities in the area were functioning normally. No factor.

3. The planned route of flight took the helicopter over mountainous and remote desert terrain. Since this is the general nature of all the terrain in the surrounding area, this should not have presented any unusual difficulties for the experienced crew. Nevertheless, mountain flying is always dangerous and requires special consideration in dealing with such situations.

Operational Factors:

1. A "company" VFR flight plan was filed for this trip in accordance with the requirements of FAR Part 135. However, no flight plan was filed with the FAA.

2. The medical and inter-hospital transfer aspects of the mission were more-or-less routine. The mission did call for a cross-country trip in excess of 100 miles one way over mountainous and desert terrain which, as it turned out, was a factor in the accident.

HYPOTHESES:

1. The pilot was just returning to work after a 4 day respite. It is possible that the extended time off had a dulling effect on his precision. He may have not been quite "up to speed" yet.

2. That the pilot obviously did not "feel" or hear the engine cowling door buffeting in the slipstream before it was torn off might have been due to a permanent or temporary physiological disorder causing a loss of hearing acuity (not uncommon among helicopter pilots) or a reduced sensitivity to vibration (a "dead butt"). It might also be possible that the pilot was distracted by some outside psychological stressor to a point where he did not notice the sound or feel of the loose cowling door.

3. If the cowling door latches in question were closed and locked but not engaged with the tabs inside the cowling itself, the door may have appeared to be secured when in fact it was not. Unless the pilot, in his preflight inspection, physically pulled on the door to check it secure, it is possible that he could have missed it.

4. It is possible that when the open left cowling door was torn off it may have damaged the No. 1 gas turbine governor throttle lever tension spring. With the tension removed, the lever, now exposed to the slip stream, would tend to move in the "decrease RPM" direction. This would in turn cause the fuel control to reduce fuel flow and essentially bring engine power to zero. The pilot should have noticed a drop in the No. 1 engine torque (unless the transmitter was not working properly) and the turbine outlet temperature but not necessarily in the main rotor (N_R) or gas producer (N_2) RPM while in a cruise condition. But if he pulled collective (power) to climb, No. 2 engine would go to maximum power while No. 1 would stay at zero, giving him at best only half the power he expected.

LESSONS LEARNED

Situational awareness is the key to good aeronautical decision making. In this situation we have looked at, analized or developed hypotheses regarding the various risk factors that comprises it, i.e. pilot, aircraft, environment, and operation. Each factor, by itself or even as part of the whole situation, does not present much in the way of inordinate risk. However, true to "Murphy's Law", which seems to be just as applicable to EMS operations as it is to everything else, things went wrong in the worst possible way in the worst possible place at the worst possible time. The unfortunate result was a fatal accident.

PREVENTATIVE ACTIONS

Lack of attention to detail was the process that forged the "Poor Judgement chain" that led to this accident. The chain could have been broken at any of several points and the accident could possibly have been avoided. For example, a more thorough pre-flight inspection may have revealed a loose or unlatched engine cowling door. A sensitivity to the unusual sound or feeling, or both, in the helicopter just after takeoff caused by the flapping cowling door may have permitted a return before it was ripped off. Finally, closer attention to the N_2 and/or TOT gauge could have alerted the pilot to the hazardous situation he was in with regard to power available.

A thorough preflight, an awareness of aircraft handling, sensitivity to unusual sounds, and careful vigilance of the gauges and instruments are common piloting activities associated with just about every flight. Normally pilots, especially experienced ones, do not need to be reminded to perform these tasks. The problem lies in the very "routineness" of these and other aspects of flying. It tends to foster a sense of complacency and, consequently, a lack of attention to detail that, combined with the tenets of Murphy's Law will eventually and inevitably lead to mishaps. To reiterate and hopefully reinforce a point made earlier: "Situational awareness is the key to good aeronautical decision making."